CLAIMS

What is claimed is:

1. In a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, the improvement comprising:

controlling the interaction between the internal combustion engine and electric motor by taking energy into the battery system only if it is more fuel efficient than throttling the engine and operating the engine at a lower efficiency.

2. An improvement as recited in claim 1, further comprising:

charging the battery system to a certain state or maintaining the battery system at a particular state of charge during operation of the vehicle.

3. A method for controlling the interaction between an internal combustion engine and electric motor operated by a battery system in a hybrid electric vehicle, comprising:

taking energy into the battery system only if it is more fuel efficient than throttling the engine and operating the engine at a lower efficiency.

4. A method as recited in claim 3, further comprising:

charging the battery system to a certain state or maintaining the battery system at a particular state of charge during operation of the vehicle.

5. An apparatus for controlling the interaction between an internal combustion engine and electric motor operated by a battery system in a hybrid electric vehicle, comprising:

a computer; and

programming associated with said computer for taking energy into the battery system only if it is more fuel efficient than throttling the engine and operating the engine at a lower efficiency.

6. An apparatus as recited in claim 5, further comprising:

programming associated with said computer for charging the battery system to a certain state or maintaining the battery system at a particular state of charge during operation of the vehicle.

7. In a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, the improvement comprising:

using engine "turn-on" speed to regulate depth of discharge of the battery system by observing average depth of discharge of the battery system over a period of time and maintaining the depth of discharge between a maximum and minimum with the engine.

8. A battery control method for an hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric

motor, comprising:

using engine "turn-on" speed to regulate depth of discharge of the battery system by observing average depth of discharge of the battery system over a period of time and maintaining the depth of discharge between a maximum and minimum with the engine.

9. A battery control apparatus for a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, comprising:

a computer; and

programming associated with said computer for using the engine "turn-on" speed to regulate the depth of discharge of the battery system by observing average depth of discharge of the battery system over a period of time and maintaining the depth of discharge between a maximum and minimum with the engine.

10. In a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, the improvement comprising:

cycling depth of discharge of the battery system with the engine to maintain the depth of discharge between a maximum and minimum.

11. A battery control method for a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric

motor, comprising:

cycling depth of discharge of the battery system with the engine to maintain the depth of discharge between a maximum and minimum.

12. A battery control apparatus method for a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, comprising:

a computer; and

programming associated with said computer for cycling depth of discharge of the battery system with the engine to maintain the depth of discharge between a maximum and minimum.

13. In a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, the improvement comprising:

setting a closed loop system to regulate depth discharge of the battery system with a frequency bandwidth sufficient to meet predetermined operating criteria;

said predetermined operating criteria selected from the group consisting essentially of battery life, vehicle range, and driveability.

14. An improvement as recited in claim 13, further comprising:

regulating depth of discharge of the battery system without fully charging the

battery system with the engine.

15. A battery control method for a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, comprising:

setting a closed loop system to regulate depth discharge of the battery system with a frequency bandwidth sufficient to meet predetermined operating criteria;

said predetermined operating criteria selected from the group consisting essentially of battery life, vehicle range, and driveability.

16. A method as recited in claim 15, further comprising:

regulating depth of discharge of the battery system without fully charging the battery system with the engine.

17. A battery control apparatus for a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, comprising:

a closed loop system configured to regulate depth discharge of the battery system with a frequency bandwidth sufficient to meet predetermined operating criteria;

said predetermined operating criteria selected from the group consisting essentially of battery life, vehicle range, and driveability.

18. An apparatus as recited in claim 17, further comprising:

a computer; and

programming associated with said computer for regulating depth of discharge of the battery system without fully charging the battery system with the engine.

19. In a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, the improvement comprising:

using vehicle speed as a determinant of vehicle energy demand from said battery system.

20. A battery control method for an hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, comprising:

using vehicle speed as a determinant of vehicle energy demand from said battery system.

21. A battery control apparatus for a hybrid electric vehicle having an internal combustion engine, an electric motor, and a battery system for powering the electric motor, comprising:

a computer; and

programming associated with said computer for using vehicle speed as a

determinant of vehicle energy demand from said battery system.

22. In a hybrid electric vehicle having an internal combustion engine, an electric motor, a battery system for powering the electric motor, and a continuously variable transmission (CVT) powertrain system, the improvement comprising:

using the electric motor and battery system to provide acceleration and deceleration compensation for the CVT powertrain system dynamics.

23. A control method for a hybrid electric vehicle having an internal combustion engine, an electric motor, a battery system for powering the electric motor, and a continuously variable transmission (CVT) powertrain system, comprising:

using the electric motor and battery system to provide acceleration and deceleration compensation for the CVT powertrain system dynamics.

24. A control apparatus for a hybrid electric vehicle having an internal combustion engine, an electric motor, a battery system for powering the electric motor, and a continuously variable transmission (CVT) powertrain system, comprising:

a computer; and

programming associated with said computer for using the electric motor and battery system to provide acceleration and deceleration compensation for the CVT powertrain system dynamics.